

Measuring Multiphase Flow through Shales

Enhancing petroleum recovery by better understanding oil migration through shales

The recovery of petroleum in an oil reservoir deals with multiphase flows of either water and oil or water, oil, and gas. Petroleum companies use kinetic models to understand oil migration in rocks that are partially saturated with water. These companies want to better understand the sealing capacity of shale and how it affects the migration of oil.

Another concern for petroleum reservoir engineers is whether Darcy's law is applicable to the flow of fluid in rocks with very low permeability ($<10^{-9}$ darcy) and, thus, whether it is valid to apply the concept of relative permeability to such rock. Our studies of permeability (both

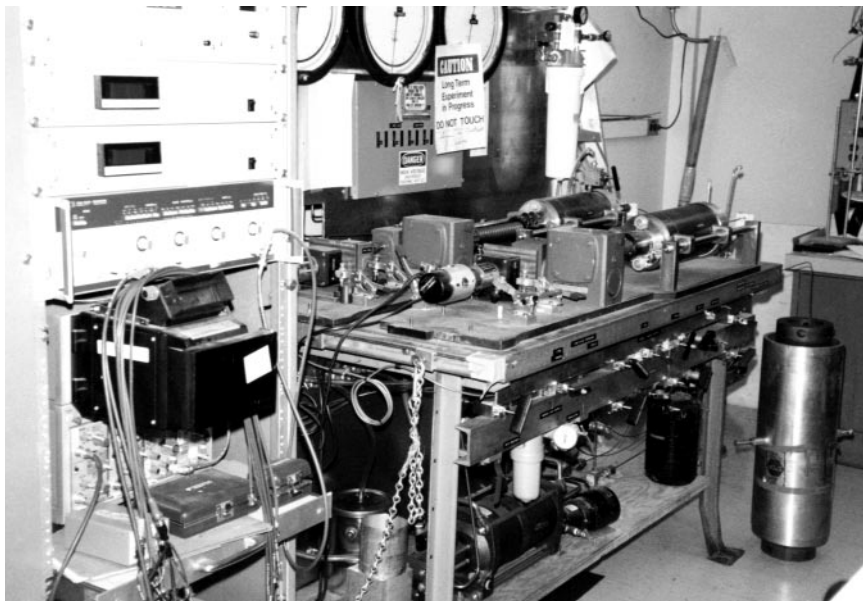
absolute liquid permeability and relative permeability) in low-permeability rocks will test Darcy's law and will allow us to investigate the possibility of measuring relative permeability.

APPLICATIONS

- Measure relative permeability in multiphase flow situations
- Model geohydrological systems

Special capabilities

At LLNL, we have measured permeability, as a function of pressure, below the nanodarcy level in granitic and argillitic rocks. We have also developed an apparatus to measure relative permeability in multiphase flow situations at pressures to 100 MPa and temperatures to 200°C. Although designed for a water-gas system, the



LLNL-developed apparatus can measure the relative permeability of a multiphase flow at pressures to 100 MPa and temperatures to 200°C.

apparatus can be converted into a water-oil or oil-gas system and used to determine relative permeability of a two- or three-phase system. In addition, we have strong geohydrological modeling capabilities to provide theoretical support for experimental studies.

Availability: The technology is available now. We are looking for industrial partners with whom to further develop our relative-permeability measuring apparatus so it can be used with water-oil and oil-gas systems.

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